Gesture-Controlled Rover: Intuitive Human Gesture Interaction for Remote Robot Control

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Abstract - *The Gesture Controlled Rover is a robot that responds to simple human motions. Robots these days are playing quite a significant role in day-to-day life. This work aims to propose a new technique to operate a robot by utilizing gestures, as well as to develop a remote-controlled robot that can be controlled using only gestures from a distance. A gesture gadget is to be worn by a user that has a sensor attached to it. As instructed by this user, the sensor records the movement made and thus the robot will move in the same instructed direction. This concept can be used to create a robot whose navigation can be automated. Gesture commands that the user can freely train and can be utilized to control external devices using a handheld wireless sensor unit. Hand movements control the accelerometer.*
***Keywords**: Robot, Arduino, micro controller, gesture, accelerometer.*

1 INTRODUCTION

Interest in robotics has increased recently. An electromechanical system that is controlled by a computer program is referred to as a robot [1][2]. Many applications have been made use of robots. Human-robot interaction (HRI) interfaces, which make robots usable by people without specialized robotics knowledge, are crucial for the development and acceptance of collaborative robots in business. Humans and collaborative robots must communicate clearly and act naturally to form a co-working relationship. It may be fully or partially autonomous. Uncontrolled by humans, an autonomous robot makes decisions on its own by perceiving its surroundings. Since they must operate with tremendous speed and accuracy, most industrial robots are autonomous. Nonetheless, some uses call for partially autonomous or human-controlled robots. The Arduino microcontroller then processes the signals received by the accelerometer. The robot is moved in the instructed direction by the microcontroller [3]. The sensors have control over the vehicle since they act as the remote control that controls the vehicle. The user will be able to control the bot's forward, backward, left, and right movements using the same accelerometer sensor that controls the bot's throttle. The differential mechanism controls the robot's movement.

User interface technology has become increasingly significant as the number of human-machine interactions (HMI) in daily life has increased. Bodily motions used as intuitive expressions will make interaction much simpler and make it easier for people to control robots or computers. Gestures can be recorded by a variety of current devices, including joysticks, trackballs, and touch tablets. Some of these can even be used as input for a gesture recognition system [4].

Robots that can be controlled by hand gestures rather than traditional buttons are known as gesture-controlled robots. Simply carry a small transmitting gadget with an acceleration meter in your hand. This will send the robot the proper command, enabling it to carry out our instructions. The transmitter and receiver are the two distinct components that make up our model [4][5]. The x and y axes of the accelerometer's analogue output are read by the Arduino microcontroller, which then translates the analogue readings to the corresponding digital values. The Arduino microcontroller processes the digital values, and in response to the tilt of the hand-mounted accelerometer sensor, it transmits the orders to the transmitter, which is then relayed, received, and processed at the receiver end to move the motor in a certain direction. When we tilt our hand forward, backward, right, and left, the robot moves in the corresponding directions. When it is parallel to the ground, the robot comes to a stop. Robotics is utilized mostly in the automotive, medical, building, and defense industries as well as in firefighting robots that rescue victims of fire accidents [5].

II LITERATURE REVIEW

Literary studies play a central role in the life cycle of every project and cannot be underestimated. The main goal of the literature review is to find new solutions by understanding the shortcomings and shortcomings of existing systems. This research is conducted early in the project, gathering information from a variety of sources, and analyzing it according to the needs of the project. This research includes investigating the shortcomings of various technologies and current technologies. This includes comparing existing designs with proposed designs. The following conclusions have been drawn from a thorough study of our project and various studies for better implementation. I briefly explained some of the excellent papers related to this project and useful [6].

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III METHODOLOGY

The slave microcontroller will receive commands from the master based on the input codes, and the robot will behave as follows. It has the following capabilities: moves forward and backward; has speed settings for both directions; and can even turn left or right while travelling ahead or backward.

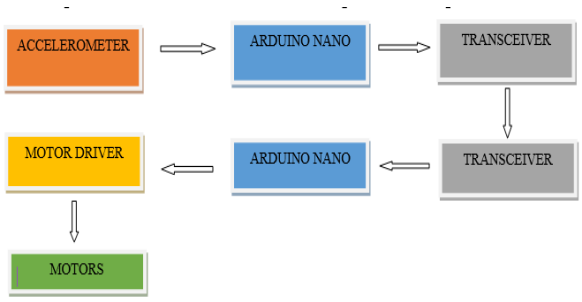

Figure 1: Methodology of Gesture Controlled Rover

The signal flow through the circuit is shown in Figure 1. Hand gestures are used to enter data, and a 3-axis accelerometer records this motion. The accelerometer in the figure above reads the X, Y, and Z coordinates as we make hand gestures. The Arduino is then given the X, Y, and Z coordinates. There is no need for the Z axis. We only need X and Y. The Rover can only go forward and backward using the Y-axis, and it can only turn using the X-axis [9].

The values that serve as the controlling parameters for movement in whatever form are chosen through practical testing. starting with a particular value and altering it as necessary. As an interface module, the Arduino NANO receives the signal from the hand unit, controls it, and transmits it to the Rover unit. As was already discussed before in the

section, the Arduino then transmits the signal to the transceiver. This transceiver functions as a transmitter in the apparatus affixed to the hand glove. This communicates accelerometer data to the transceiver attached to the Rover unit. This transceiver module plays the part of a receiver by collecting information that has been transmitted to a particular constant byte address that was specified in the base program. Using this constant byte address, also referred to as a "pipe," it is possible to choose which transmitter to utilize or which receiver to send data or signals to. The data gathered is now used to control the motors [9][10].

To drive the motor in a manner that carries out the motion by the data collected, we use techniques. For example, we use one motor from the rover's front axle on one side and one motor from its rear axle on the opposite side of the first selected motor to propel the rover ahead. However, we use the other two motors that weren't mentioned in the prior scenario to propel the rover backward.

This approach is taken to make things straightforward and prevent oversimplifying the responsibilities that each motor plays in each type of motion. Like moving forward and backward, spinning can be done by switching the rover's motors from one side to the other. To turn the rover to the right, for instance, move the left-side motors only forward, and to the left, move the right-side motors just backward. The Rover stops moving in the absence of input or when the hand is not moving, leaving the accelerometer motionless or reading 0 g.

Advantages and Limitations

Advantages

- Arduino NANO is comparatively cheaper and easily accessible when compared to other AT Mega-derived Boards in the market. Its tiny size makes it perfect for compact works without any compromise in functionality and is an easy fit to a breadboard which makes prototyping easier.
- Can be controlled from a distance at sight which makes it easier for physically disabled beings.
- The usage of the upgraded transceiver increases the range from a normal RF module by more than 300 meters.

Limitations

- The 9V batteries used offer only a limited amount of power to the system. Some alternate sources of power would be more helpful in place of batteries.
- An onboard camera can be installed for monitoring the robot from faraway places. All we need is a wireless camera that will broadcast and a receiver module that will provide live streaming.

IV RESULTS AND DISCUSSION

Accelerometer sensors attached to a hand glove power the model's rover. The sensor will take the place of the current remote control for the rover. When the hand moves from the bottom to the top, the rover is supposed to move forward. Also, the rover is supposed to advance backward when the hand moves from top to bottom. The rover is anticipated to

move in that direction because of the hand's sharp angle to the left. The rover is assumed to move in the direction indicated by the hand pointing acutely to the right. While the hand is held still, the rover is kept static regarding its surroundings. We can therefore anticipate a rover that can recognise humans [11].

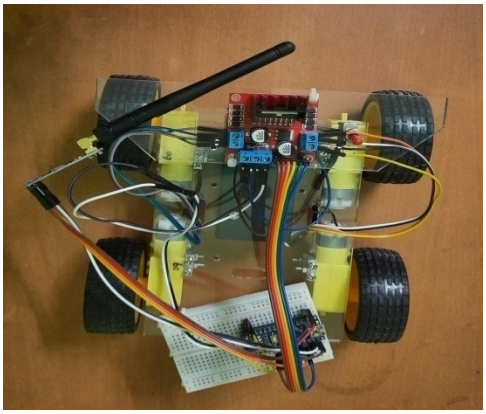

Figure 2: Gesture Controlled Rover

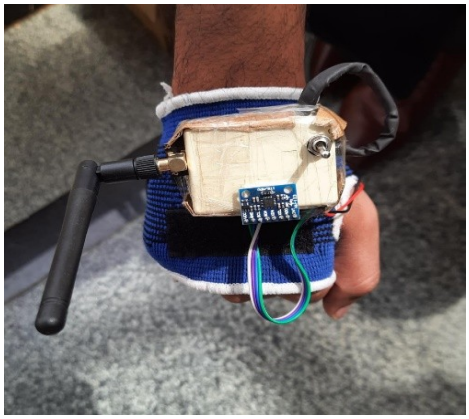

Figure 3: Controlled Rover

Table 1: Table representing the direction of Robot

Hand Gesture	Direction of Robot
Top to Bottom	Forward
Bottom to top	Backward
Acute angle - Left	Left side
Acute angle - Right	Right side
Stationary	Stop mode

V CONCLUSION

The Hand Gesture controlled Rover can reduce the labor force by using it in various fields instead of human labor and is developed with readily available components making the model inexpensive and efficient. This model can also be reduced in size for use in medical and scientific applications. The model plays a major role in saving human life in the case of landmine detection and monitoring.

Future Work

- Employing cameras for military surveillance and archaeology uses, increasing the robotic vehicle's wireless connection capability.
- Using user interfaces such as an Android app and supplying location, the system can be further customized.

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